EXIT PRESENTATION

MASS AND RELIABILITY SOURCE DATABASE

NC4

Ryan Ogilvie

Karl Rothe

MARS

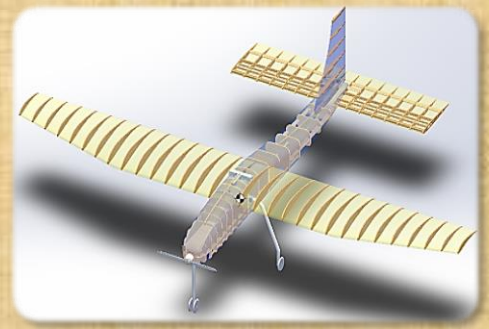
RYAN OGILVIE - ABOUT ME

HAS ALUMNI

FIRST Robotics ALUMNI

THE UNIVERSITY of TULSA
Mechanical Engineering

PCB Design



Plane Design

Quadcopter Design

EAGLE SCOUT
BOY SCOUTS OF AMERICA
BE PREPARED

Alpha Phi Omega

Tulsa SAE aero Team (Plane from Design)

Last Summer Internship (Daltile)

Painting

Family + Outdoors

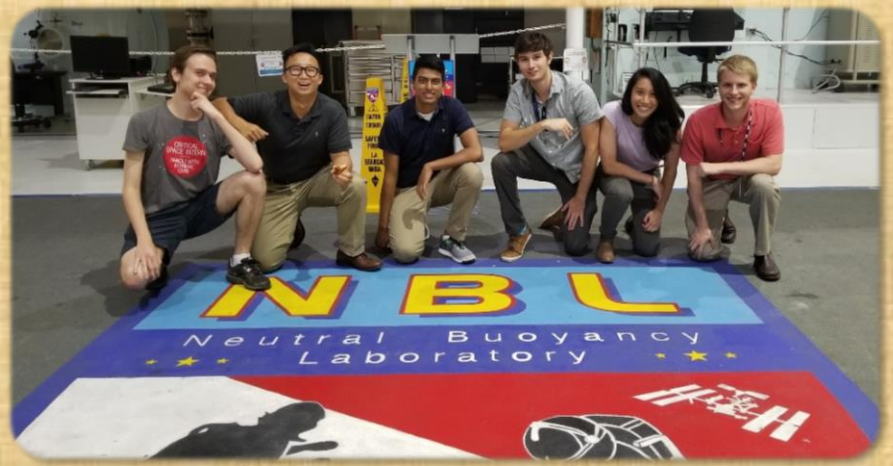
WW2 Plane Restoration – Tulsa CAF

RYAN OGILVIE - JSC EXPERIENCE

Bible Study with Astronaut David Leestma

Astronaut Timothy "TJ" Creamer

Astronaut Douglas "Wheels" Wheelock



NBL movie night

Astronaut Clayton Anderson

Floor tour of MCC

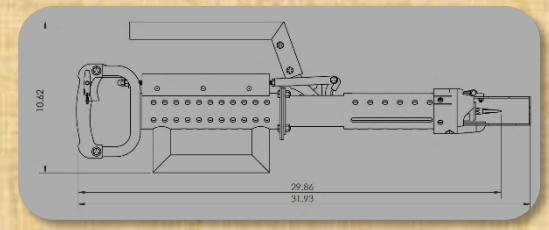
Galveston at Dawn

Flight Director Gene Kranz

KARL ROTHE – ABOUT ME

FIRST Robotics Alumni

Marching Band



Micro-G NExT

Formula SAE

My cat

Robotics Lab

Girlfriend

1st Internship

KARL ROTHE – JSC EXPERIENCE

PAXC trip to Wallops

Grand Theft MRV

My robot friend

Astronaut
Clayton Anderson

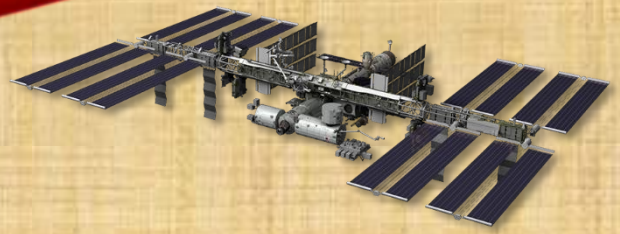
Flight Director
Gene Kranz

Sounding Rocket
Launch Pad

JWST

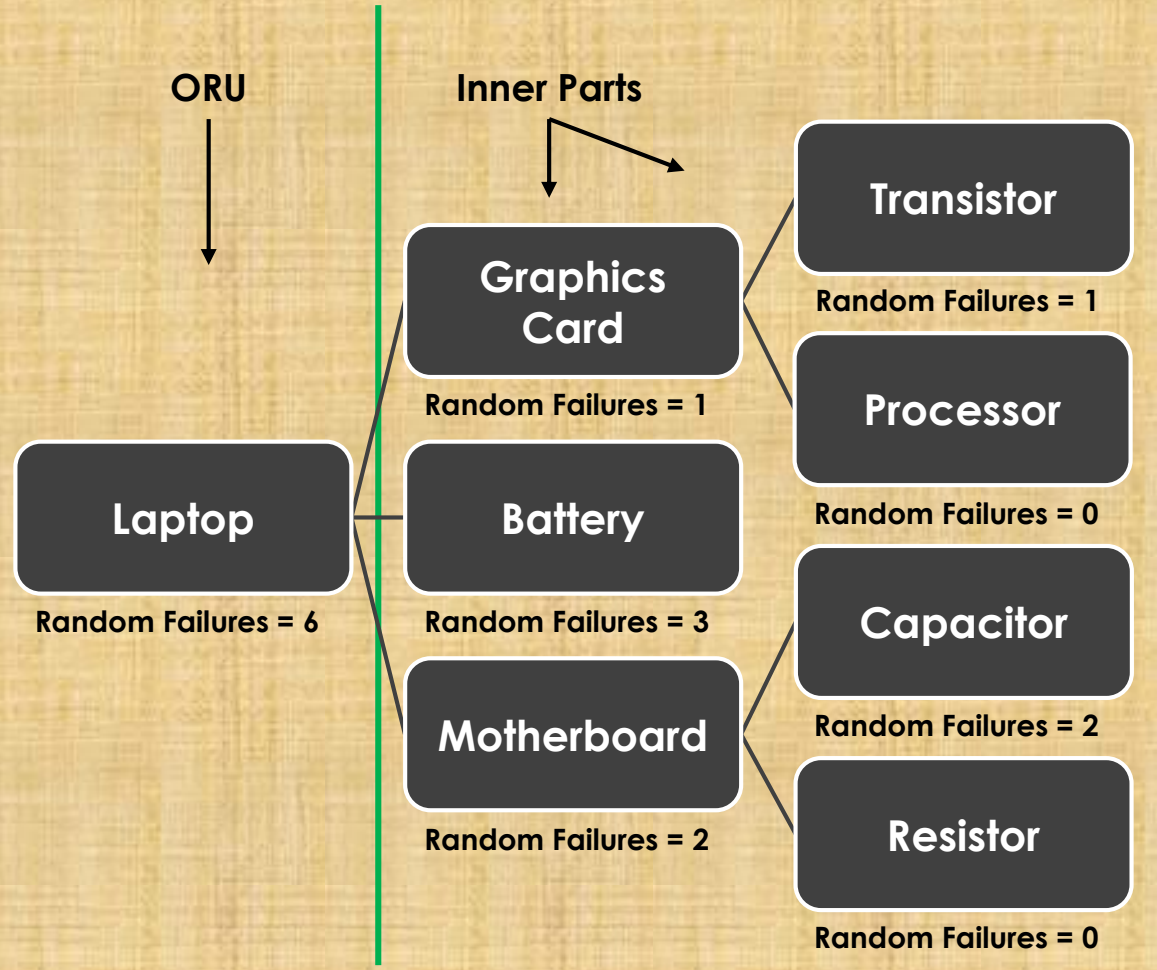
SAIL Lab

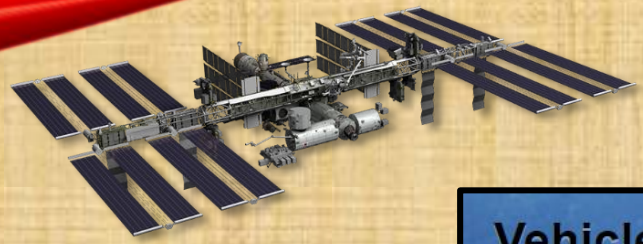
Anechoic Chamber



DATABASE OVERVIEW

- MaRS: database of components on ISS
- Purpose: Planning of spare parts for deep space missions
- Contains: MADS ORUs with parts list, mass, and reliability data

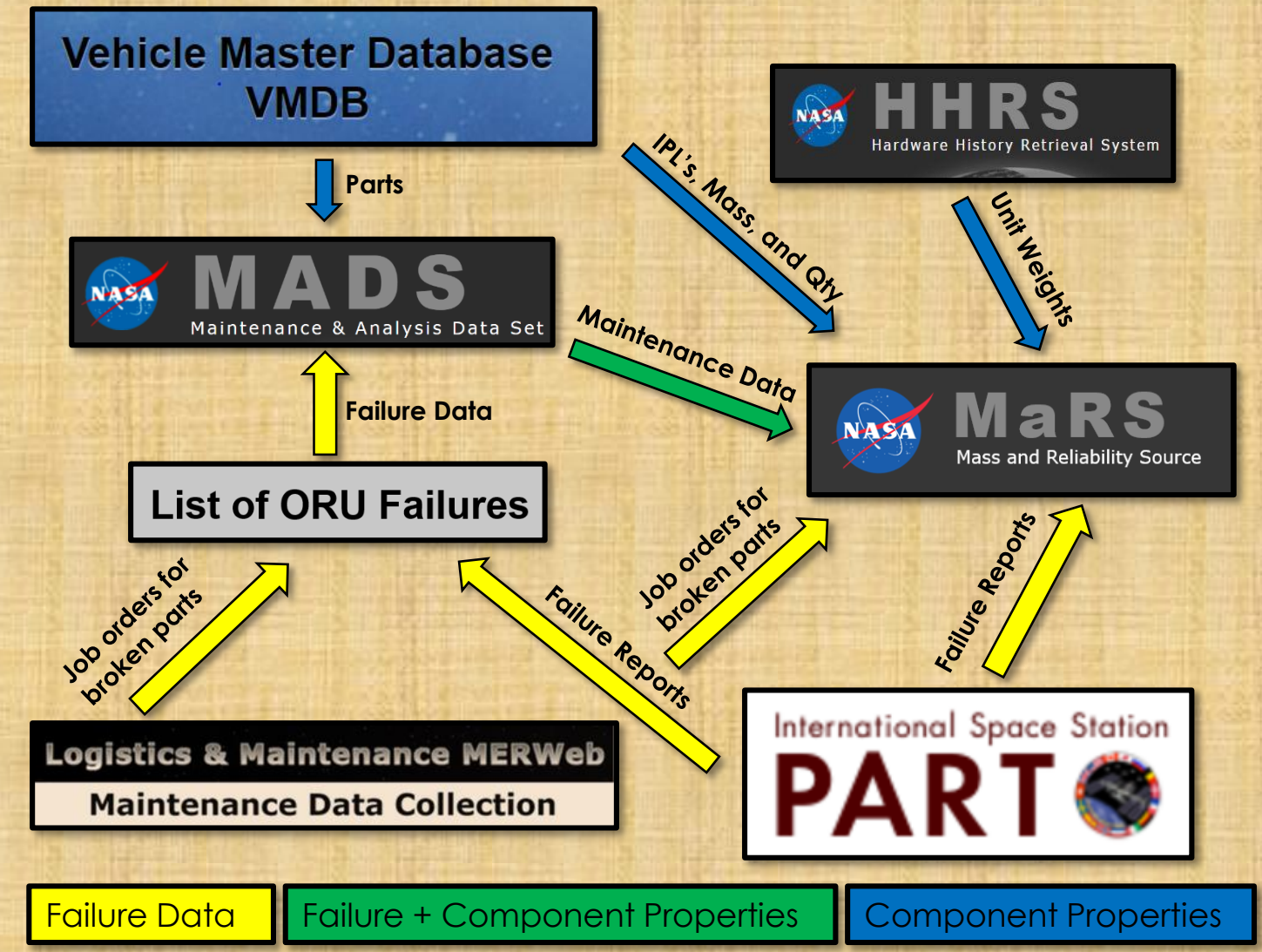




DATABASE OVERVIEW

- MaRS is based on MADS
- Other databases add component and failure Information

- New Databases found
  - "List of ORU Failures"
  - "Maintenance Data Collection"



NEW DATABASE FAILURE LIST

- PowerPoint references to PART records and Job Orders
- This was compiled into one dataset of referenced Reports and Job Orders

S&M System – Internal ORU Failures

- **L&M Failures: Random Failures – 1**

ORU	Fail Date	Failure Type	Job Order	PART
Powered Bolt Assy	04/20/2014	Unknown	ISS14-1233	8872

- **L&M Failures: K-Factor Failures – 5**

ORU	Fail Date	Failure Type	Job Order	PART
Panel Assy. Fastener	03/27/2001	K-Factor	ISS01-0708	5671
Control Panel Assy (CPA)	02/13/2001	K-Factor	ISS01-0013	5653
Integrated Hose Assy	12/21/2003	K-Factor (ECLSS)	ISS04-0297	6567
Scratch Pane	01/31/2006	K-Factor	ISS06-0181	6443
Hatch Seal Assy	04/17/2008	K-Factor	ISS08-1109	2801

- **L&M Failures: Other Failures – 6**

ORU	Fail Date	Failure Type	Job Order	PART
Hatch Roller Assy	12/12/1998	Design Flaw	ISS01-0138	4047
Hatch Track	12/12/1998	Design Flaw	ISS01-0139	4047
Hatch Seal Assy	05/30/2005	Other	ISS05-1519	6450
Powered Bolt Assy	09/02/2009	Manufacturing Defect	ISS09-2096	7218
Hatch Seal Assy	12/14/2009	Other	ISS09-3081	N/A
Hatch Seal Assy	08/30/2010	Other	ISS10-2447	7623

- Note: Updates since last Failure History Review are highlighted in blue.

Page No. 75
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Pre-decisional, For Internal Use Only

MADS
Maintenance & Analysis Data Set
List of ORU Failures

+

Logistics & Maintenance MERWeb
Maintenance Data Collection

+

International Space Station
PART

=

<table>
<tr><th colspan="4">Compilation of source(s)</th><th colspan="7">Job Order</th><th colspan="3">IFI</th><th colspan="3">PRACA</th><th colspan="10">Original failure analysis for MADS</th><th colspan="7">Baysian analysis PPT (MADS SOURC…</th></tr>
<tr><th>Possible Part Numbers</th><th>Possible Part Name(s)</th><th>…le MADS ID</th><th>…W or Software</th><th>Job Order</th><th>Partnumber</th><th>Part Name</th><th>…from Job Order</th><th></th><th></th><th></th><th>…t type 1 (IFI)</th><th>Partnumber</th><th>Part Name</th><th>PRACA</th><th>Partnumber</th><th>Part Name</th><th></th><th></th><th>Part Number</th><th>Part Name</th><th></th><th>…et #</th><th></th><th>…dom Failure?</th><th>…ware/Software Requires Replacement?</th><th>Notes</th><th>Page num</th><th>System/Subsystem</th><th>Header</th><th>Descriptor type</th><th>Descriptor</th><th>Fail Date</th><th>MA…</th></tr>
<tr><td>683-61592-2</td><td>(Actuator #10)|ACTUATOR ASSEMBLY</td><td>2082|2084|2085|20(</td><td>L&M Faik</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>7398</td><td>683-61592-2</td><td>ACTUATOR ASSEMBLY</td><td>873</td><td>812</td><td>683-61592-2</td><td>ACTUATOR ASSEN</td><td>7398</td><td>40086</td><td>U</td><td>H</td><td>Y</td><td>IFL, with multip</td><td>11</td><td>ARIS</td><td>L&M Failures</td><td>ORU</td><td>Actuator #10</td><td>9/30/2009</td><td>Induce</td></tr>
<tr><td>P/N 683-61591-2; S/N</td><td>(Actuator #13)|Actuator</td><td></td><td>L&M Faik</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>7409</td><td>P/N 683-61591-2; S/I</td><td>Actuator</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>11</td><td>ARIS</td><td>L&M Failures</td><td>ORU</td><td>Actuator #13</td><td>10/19/2009</td><td>Induce</td></tr>
<tr><td>683-61599-5|P/N 683-</td><td>(Pushrod #5)|PUSHROD, ASSEMBLY|ACTUA</td><td></td><td>L&M Faik</td><td>ISS11-0423</td><td>683-61599-5</td><td>PUSHROD, ASSEMBLY</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>7754</td><td>P/N 683-61599-5 & F</td><td>Pushrod and Actuator</td><td>1</td><td>2</td><td>683-61592-4</td><td>ACTUATOR ASSEN</td><td>7754</td><td>40568</td><td>N</td><td>H</td><td>N</td><td>Incorrect on-or</td><td>11</td><td>ARIS</td><td>L&M Failures</td><td>ORU</td><td>Pushrod #5</td><td>1/24/2011</td><td>Induce</td></tr>
<tr><td>683-61599-5|P/N 683-</td><td>(Actuator #5)|PUSHROD, ASSEMBLY|ACTU</td><td></td><td>L&M Faik</td><td>ISS11-0423</td><td>683-61599-5</td><td>PUSHROD, ASSEMBLY</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>7754</td><td>P/N 683-61599-5 & F</td><td>Pushrod and Actuator</td><td>1</td><td>2</td><td>683-61592-4</td><td>ACTUATOR ASSEN</td><td>7754</td><td>40568</td><td>N</td><td>H</td><td>N</td><td>Incorrect on-or</td><td>11</td><td>ARIS</td><td>L&M Failures</td><td>ORU</td><td>Actuator #5</td><td>1/24/2011</td><td>Induce</td></tr>
<tr><td>683-61600-2</td><td>(Pushrod Upper Right)|ARIS KIT INSTALLATI</td><td></td><td>L&M Faik</td><td>ISS13-0513</td><td></td><td></td><td></td><td></td><td></td><td></td><td>8360</td><td>683-61600-2</td><td>ARIS KIT INSTALLA</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>11</td><td>ARIS</td><td>L&M Failures</td><td>ORU</td><td>Pushrod Upper Right</td><td>2/5/2013</td><td>Induce</td></tr>
<tr><td>683-61600-2</td><td>(Actuator Upper Right)|ARIS KIT INSTALLAT</td><td></td><td>L&M Faik</td><td>ISS13-0513</td><td></td><td></td><td></td><td></td><td></td><td></td><td>8360</td><td>683-61600-2</td><td>ARIS KIT INSTALLA</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>11</td><td>ARIS</td><td>L&M Failures</td><td>ORU</td><td>Actuator Upper Right</td><td>2/5/2013</td><td>Induce</td></tr>
<tr><td>683-61600-2</td><td>(Pushrod Upper Left)|ARIS KIT INSTALLATIC</td><td></td><td>L&M Faik</td><td>ISS13-0513</td><td></td><td></td><td></td><td></td><td></td><td></td><td>8360</td><td>683-61600-2</td><td>ARIS KIT INSTALLA</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>11</td><td>ARIS</td><td>L&M Failures</td><td>ORU</td><td>Pushrod Upper Left</td><td>2/5/2013</td><td>Induce</td></tr>
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<tr><td>683-61599-7</td><td>(Pushrod #7 Upper Left)|PUSHROD, ASSEM</td><td>2120|2121|2122|21</td><td>L&M Faik</td><td>ISS01-0497</td><td>683-61599-7</td><td>PUSHROD, ASSE</td><td>2853</td><td>5911</td><td>683-615</td><td>Pushrod Ass</td><td></td><td></td><td></td><td>5911</td><td>683-61599-7</td><td>Pushrod Assembly, Upper Lef</td><td>6</td><td>7.10</td><td>683-61591-8</td><td>FLEX COUPLING A</td><td>5911</td><td>37208</td><td>N</td><td>H</td><td>Y</td><td>Pushrod flexure</td><td>12</td><td>ARIS</td><td>L&M Failures: Not Applicab</td><td>ORU</td><td>Pushrod #7 Upper Left</td><td>11/13/2001</td><td>Other</td></tr>
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<tr><td>683-61599-8</td><td>(Pushrod #7 Upper Left)|Pushrod Assemblie</td><td>2123|2124|2125|21</td><td>L&M Faik</td><td>ISS02-0406</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>6083</td><td>683-61599-8</td><td>Pushrod Assemblies</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>12</td><td>ARIS</td><td>L&M Failures: Not Applicab</td><td>ORU</td><td>Pushrod #7 Upper Left</td><td>1/30/2002</td><td>Other</td></tr>
<tr><td></td><td>(LL Thumb Latch)</td><td></td><td>Not-Appli</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>13</td><td>ARIS - Non-</td><td>Not-Applicable Non-ORU F</td><td>Component</td><td>LL Thumb Latch</td><td>11/28/2009</td><td>Induce</td></tr>
<tr><td></td><td>(LL Thumb Latch)</td><td></td><td>Not-Appli</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>13</td><td>ARIS - Non-</td><td>Not-Applicable Non-ORU F</td><td>Component</td><td>LL Thumb Latch</td><td>9/12/2010</td><td>Induce</td></tr>
<tr><td>683-61664-11</td><td>(LL Thumb Latch)|ARIS Snubber Bottom Lef</td><td></td><td>Not-Appli</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>8193</td><td>683-61664-11</td><td>ARIS Snubber Bott</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>13</td><td>ARIS - Non-</td><td>Not-Applicable Non-ORU F</td><td>Component</td><td>LL Thumb Latch</td><td>10/4/2012</td><td>Induce</td></tr>
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</table>

Failure analysis compilation sheet in the MaRS database

REDEFINING THE DATABASE

1. Merged "Metadata" sheet into components list
2. Added Columns:
   - Location, System, MADS ID, Checked, Weight Source
   - Metadata: Material & Tier 1;2;3;4
3. Removed:
   - Unnecessary columns
   - Broken Macros
   - Unnecessary colors

Removed Macros

Removed Columns

Index	Address	Part Number	Part Name	Data In VMDB?	Weight Approval	Data In MADS	Operating Hours	Random Failures	Random Software Failures	Unit Weight (lbm)	ORU	Quantity	Unique Parts in Assembly
1	1	683-61592-3	ACTUATOR ASSEMBLY				144335.95	0	0	3.700	Y	1	48
2	1.1	683-61593-1	PIVOT ARM ASSEMBLY				144335.95	0	0	0.169	N	1	3
3	1.1.1	683-61593-13	PIVOT ARM				144335.95	0	0	0.169	N	1	
4	1.1.2	MS21209C0210	INSERT, SCREW THREAD, COARSE AND FINE, SCREW LO(				144335.95	0	0	0.000	N	4	
5	1.1.3	MS21209C0410	INSERT, SCREW THREAD, COARSE AND FINE, SCREW LO(				144335.95	0	0	0.000	N	6	
6	1.2	683-61593-10	THERMAL SPACER, SHIM				144335.95	0	0	0.002	N	1	
7	1.3	683-61593-11	THERMAL SPACER, BUSHING				144335.95	0	0	0.000	N	2	
8	1.4	683-61593-12	STOP, OVER TRAVEL				144335.95	0	0	0.008	N	2	
9	1.5	683-61593-17	THERMAL SPACER, LIGHT EMITTING DIODE				144335.95	0	0	0.000	N	1	

Old MaRS

Added Columns

Index	Address	Part Number	Part Name	MADS ID	Location	System	Operating Hours	Random Failures	Software Failures (Random)	Unit Weight (lbm)	Weight Source	Quantity	Material	Tier 1	Tier 2	Tier 3	Tier 4	Checked
361	5	683-61599-5	PUSHROD, ASSEMBLY	2108	5:LAi	ARIS	81375	0	0	0.15	VMDB	2						Verified
362	5.1	683-61591-1	ROD		5:LAi	ARIS	81375	0	0			1						Verified
363	5.2	683-61591-10	GUARD		5:LAi	ARIS	81375	0	0			1						Verified
364	5.3	683-61591-11	GUARD COVER		5:LAi	ARIS	81375	0	0			1						Verified
365	5.4	683-61591-13	MUSIC WIRE		5:LAi	ARIS	81375	0	0			1						Verified
366	5.5	683-61591-14	MUSIC WIRE		5:LAi	ARIS	81375	0	0			1						Verified
367	5.6	683-61591-5	WIRE FLEXURE COUPLING		5:LAi	ARIS	81375	0	0			1						Verified
368	5.7	683-61591-6	WIRE FLEXURE COUPLING		5:LAi	ARIS	81375	0	0			1						Verified
369	5.8	683-61591-7	FLEX COUPLING ATTACHMENT - ACTUATOR		5:LAi	ARIS	81375	0	0			1						Verified

New MaRS

UPDATES AND VERIFICATION

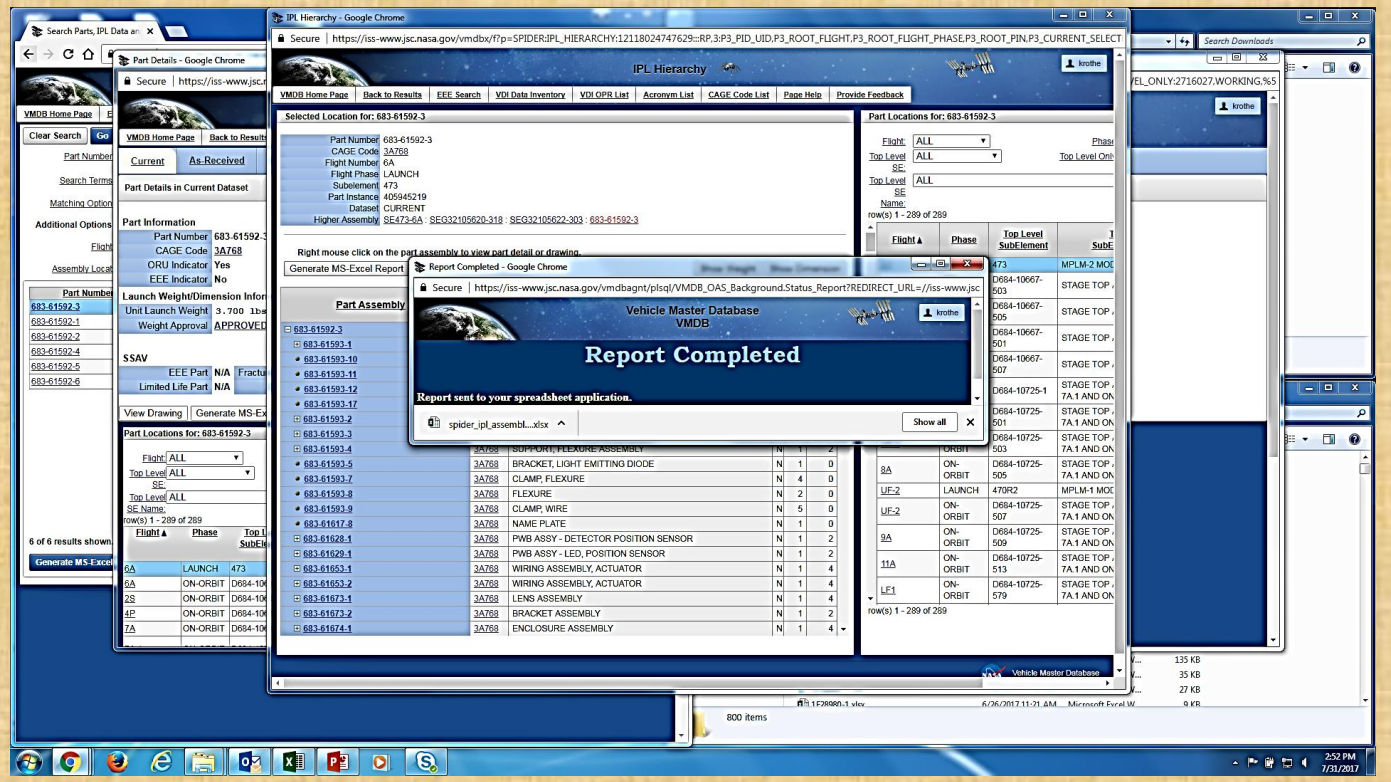
- Verified components in MaRS with MADS and their IPLs
- Added 400+ missing MADS ORU's with their IPLs
  - 40,000 new lines for a total of 120,000 lines
- Checked IPLs vs. newly downloaded IPLs for 800+ parts

Tier 4 / Checked
Verified with Name Mismatch
Verified with Name Mismatch
Verified with Name Mismatch
not in mads
not in mads
Possibly Missing IPL
Verified with Name Mismatch
not in mads
Possibly Missing IPL
Possibly Missing IPL
Verified with Name Mismatch
Verified with Name Mismatch
Verified with Name Mismatch
Verified with Name Mismatch
Verified with Name Mismatch
Verified with Name Mismatch

Errors we found

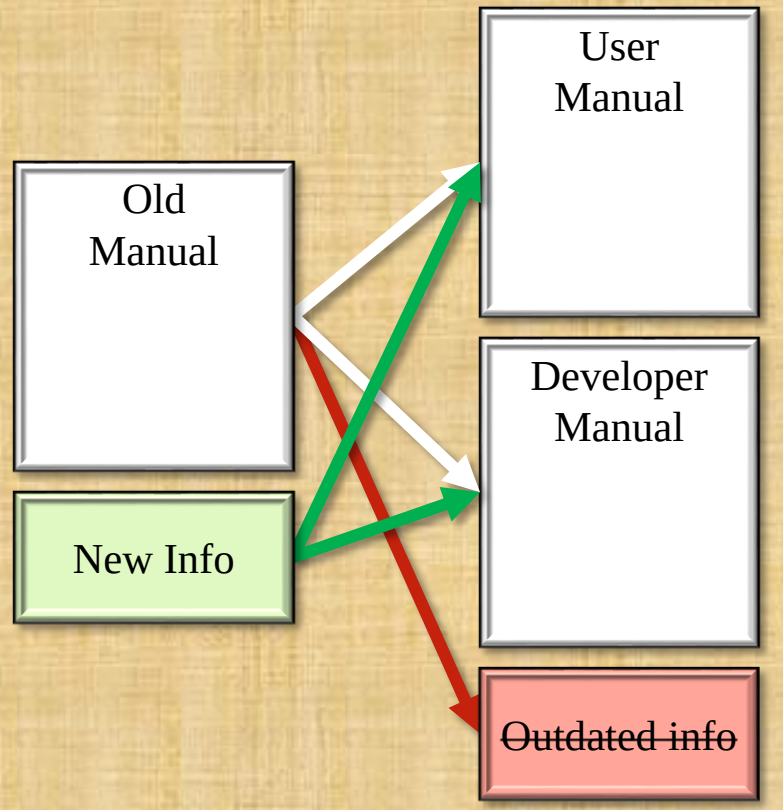
DOWNLOADING IPLS

- Manually
  - 20 mouse and keyboard inputs
  - 3-7 minutes each
- Macro Assistance
  - 8 mouse inputs
  - 1-2 minutes each



DOCUMENTATION UPDATE

- Removed outdated information
- Quick reference tables
- Glossary of terms
- End-user edition and developer edition



CONCLUSION - KARL

- Impact of Internship
  - Structure of NASA
  - Communication and teamwork skills
  - Confirmed desire for a career in aerospace
- Future Plans
  - Apply to Pathways
  - Electrical Engineering Degree
  - Move to JSC area
  - Seeking career in aerospace

CONCLUSION - RYAN

- Impact of Internship
  - Understanding of failure analysis
  - Probability and risk analysis
  - NASA's missions and goals
  - Communication in teams
  - Furthered my interest in working for NASA
- Future Plans
  - Mechanical Engineering Degree (May 2018)
  - Masters in Mechanical or Aerospace Engineering (Fall 2018)
  - Apply to NASA as Pathways or internship
  - Pursue a job in space industry

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- Jessica Mclaughlin
- NA Directorate
- NC Division

QUESTIONS?

NASA

NASA-JSC SAFETY AND MISSION ASSURANCE
EVER VIGILANT

MARS